What is claimed is:

1. A wireless communication system including a plurality of transmitting antennas and a plurality of receiving antennas through which signals are transmitted and received, the wireless communication system comprising:

a transmitter that restores feedback information from a predetermined feedback signal, weights an information signal with the restored feedback information, and converts the weighted information signal to a radio frequency signal in order to transmit the radio frequency signal; and

a receiver that receives the radio frequency signal to estimate the state of a channel through which the radio frequency signal is transmitted, calculates a weight of a dimensionality corresponding to the number of the transmitting antennas, approximates the weight as lower-dimensional one to extract feedback information, and converts the feedback information into a radio frequency signal to send the radio frequency signal to the transmitter.

2. The wireless communication system of claim 1, wherein the receiver comprises:

a baseband processor that extracts a baseband signal from the radio frequency signal and estimates the channel state;

a feedback information approximation unit that calculates the weight of a dimensionality corresponding to the number of the transmitting antennas, which maximizes a predetermined objective function, and approximates the weight as lower-dimensional one to extract the feedback information; and

a feedback unit that sends the feedback information back to the transmitter.

3. The wireless communication system of claim 2, wherein the predetermined objective function is $P=\mathbf{W}^H\mathbf{H}^H\mathbf{H}\mathbf{W}$, where a matrix **H** denotes the channel state, a vector **W** denotes the weight, and the superscript H denotes a Hermitian operator, the feedback information approximation unit calculates $\mathbf{W}_{opt}$ that maximizes the objective function and approximates $\mathbf{W}_{opt}$ to a lower dimension constituted by a predetermined basis vectors to extract the feedback information.

4. The wireless communication system of claim 3, wherein $\mathbf{W}_{opt}$ is an eigenvector corresponding to a maximum eigenvalue of $\mathbf{H}^H\mathbf{H}$ in the objective function.

5. The wireless communication system of claim 1, wherein the transmitter comprises:

a feedback information restoring unit that restores feedback information from the radio frequency signal received from the receiver;

a baseband processor that encodes and modulates an information signal;

a weighting unit that multiplies the restored feedback information by an output signal of the baseband processor; and

a radio frequency processor that converts an output signal of the weighting unit to a radio frequency signal to output the radio frequency signal.

6. A wireless communication system including a plurality of transmitting antennas and a plurality of receiving antennas through which signals are transmitted and received, respectively, the wireless communication system comprising:

a transmitter that restores feedback information from a predetermined feedback signal, weights an information signal with the restored feedback information, and converts the weighted information signal into a radio frequency signal in order to transmit the radio frequency signal; and

a receiver that receives the radio frequency signal to estimate the state of a channel through which the radio frequency signal is transmitted, selects a number of basis vectors and their coefficients corresponding to the dimensionality of approximation among the basis vectors whose number corresponds to the number of the transmitting antennas, obtains a plurality of weights from the selected basis vectors and coefficients, extracts a weight that maximizes a predetermined objective function obtained from the channel state among the plurality of weights as feedback information, and converts the feedback information into a radio frequency signal in order to send the radio frequency signal to the transmitter.

7. The wireless communication system of claim 6, wherein the receiver comprises:

a baseband processor that extracts a baseband signal from the radio frequency signal and estimates the channel state;

a feedback information approximation unit that selects a number of basis vectors and their coefficients corresponding to the dimensionality of approximation among the basis vectors whose number corresponds to the number of the transmitting antennas, obtains a plurality of weights from the selected basis vectors and coefficients, extracts a weight that maximizes a predetermined objective

function obtained from the channel state among the plurality of weights as feedback information; and

a feedback unit that sends the feedback information back to the transmitter.

8. The wireless communication system of claim 7, wherein an objective function is $P_i = W_i^H \mathbf{H}^H \mathbf{H} W_i$, where a matrix **H** denotes the channel state, a vector W_i is a weight calculated from i-th selected basis vector and coefficient, and the superscript H is a Hermitian operator, the feedback information approximation unit extracts the weight W_i that maximizes the objective function as the feedback information.

9. A wireless communication method in which, when M radio frequency signals transmitted from a transmitter are received through multiple paths, feedback information is extracted from the received signals and the feedback information is sent to the transmitter, the method comprising the steps of:

(a) estimating states of channels comprising the multiple paths from the received signals;

(b) calculating a weight, which is fed back into the transmitter and multiplied by the M radio frequency signals, from the channel state;

(c) approximating the weight as dimension S which is less than M and quantizing coefficients for the approximated dimension; and

(d) feeding basis vectors and their quantized coefficients of the approximated dimension, or indices that identify the basis vectors and their quantized coefficients, back to the transmitter.

10. The method of claim 9, wherein, in the step (b), when the number of multiple paths is L, $\mathbf{W}_{opt}$ that maximizes an objective function expressed by $P=\mathbf{W}^H \mathbf{H}^H \mathbf{H} \mathbf{W}$ is extracted as the feedback information, where a matrix **H** having a size of L x M denotes the channel state, a vector **W** having magnitude of M denotes the weight, and the superscript H denotes a Hermitian operator.

11 The method of claim 10, wherein the step (c) comprises the steps of:

(c1) determining basis vectors that represent the M dimensions;

(c2) calculating coefficients corresponding to the basis vectors from the inner product of the $\mathbf{W}_{opt}$ and each basis vector;

(c3) selecting S coefficients among the coefficients calculated in the step (c2) in order of magnitude and selecting basis vectors corresponding to the selected coefficients; and

(c4) quantizing the selected coefficients.

12. The method of claim 9, if feedback signal includes the basis vectors and the quantization coefficients in the step (d), further comprising the steps of:

(e) extracting the basis vectors and the quantization coefficients from the feedback signal received from the transmitter;

(f) restoring feedback information from the extracted basis vectors and the quantization coefficients;

(g) weighting an information signal to be transmitted with the restored feedback information; and

(h) transmitting the weighted information signal.

13. The method of claim 9, if feedback information includes the indices in the step (d), further comprising the steps of:

(e) storing the base vectors and the quantization coefficients of S dimensions and indices identifying the basis vectors and the quantization coefficients, respectively, in the transmitter;

(f) extracting the indices from a received feedback signal and basis vectors and quantization coefficients identified by the indices among the base vectors and the quantization coefficients stored in the step (e);

(g) restoring feedback information from the extracted basis vectors and the quantization coefficients;

(h) weighting an information signal to be transmitted with the restored feedback information; and

(i) transmitting the weighted information signal.

14. A wireless communication method in which, when M radio frequency signals transmitted from a transmitter are received through multiple paths, feedback information is extracted from the received signals and the feedback information is sent to the transmitter, the method comprising the steps of:

(a) estimating states of channels comprising the multiple paths from the received signals;

(b) determining basis vectors that represent M dimensions;

(c) selecting S basis vectors among the determined basis vectors where S is less than M;

(d) selecting one of N quantization coefficients for each basis vector;

(e) obtaining feedback information W_i from the selected basis vectors and quantization coefficients; and

(f) sending W_i or an index indicating W_i back to the transmitter if a predetermined objective function P_i generated from W_i and the estimated channel **H** reaches a maximum.

15. The method of claim 14, wherein the objective function P_i is expressed by $P_i = W_i^H \mathbf{H}^H \mathbf{H} W_i$ where the superscript H is a Hermitian operator.

16. The method of claim 14, wherein, if the predetermined objective function P_i does not reach a maximum, the steps (e) and (f) are repeated for ${}_{M}C_{S}$ cases in which another S basis vectors are selected from the M basis vectors and for N^S cases in which another quantization coefficient is selected for each of the selected S basis vectors.

17. The method of claim 14, if feedback information includes W_i in the step (f), further comprising the steps of:

(g) extracting W_i from a received feedback signal;

(h) weighting an information signal to be transmitted with the extracted W_i ; and

(i) transmitting the weighted information signal.

18. The method of claim 14, if feedback information includes the index in the step (f), further comprising the steps of:

(g) storing selectable W_i and index indicating W_i in the transmitter;

(h) extracting the index from a received feedback signal and W_i identified by the index;

(i) weighting an information signal to be transmitted with the extracted W_i; and

(j) transmitting the weighted information signal.

19. The wireless communication system of claim 5, wherein the predetermined objective function is $P=\mathbf{W}^H\mathbf{H}^H\mathbf{H}\mathbf{W}$, where a matrix **H** denotes the channel state, a vector **W** denotes the weight, and the superscript H denotes a Hermitian operator, the feedback information approximation unit calculates $\mathbf{W}_{opt}$ that maximizes the objective function and approximates $\mathbf{W}_{opt}$ to a lower dimension constituted by a predetermined basis vectors to extract the feedback information.

20. The wireless communication system of claim 5, wherein $\mathbf{W}_{opt}$ is an eigenvector corresponding to a maximum eigenvalue of $\mathbf{H}^H\mathbf{H}$ in the objective function.